

USAWC STRATEGY RESEARCH PROJECT

ENVIRONMENTAL SECURITY: A STRATEGY FOR THE MITIGATION OF REGIONAL INSTABILITIES?

by

JOE D. MANOUS, JR
United States Army

Dr. Kent Butts
Project Advisor

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U.S. Army War College
CARLISLE BARRACKS, PENNSYLVANIA 17013

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ABSTRACT

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Maintaining regional stability has risen in importance in United States foreign policy and in some instances has risen to the level of a vital national interest. However, the current role of the United States as the world's sole hyperpower has produced unique challenges as the United States confronts asymmetric threats from terrorist (non-state) organizations. Of special interest to the United States military is the prevention or mitigation of regional instabilities. These instabilities hamper economic prosperity and provide breeding grounds for popular discontent. While regional instabilities alone may not constitute a direct physical threat to the United States, their secondary effects, which include impacts on international trade, access to resources, and support bases for terrorist organizations, have major implications for United States national security interests.

The unprecedented growth of the world's population, particularly in developing nations, is consuming the basic resources of food and water at an alarming rate, while the spread of epidemic diseases such as HIV/AIDS, tuberculosis, and malaria are destroying entire generations. In developing countries, the populations often focus much of their energy fulfilling the basic needs of food and water and when these needs are not met, an internal disruption of the State can result. While these "environmental issues" may not provide the sole reason for a population to take up arms, they can contribute to general discontent and accentuate other contentious matters.

This paper presents a definition for "environmental security" and a rationale for why the United States, and especially Unified Geographic Combatant Commands, should engage in environmental issues that conflict with United States' national interests. The major environmental threats facing the world in the 21st Century are presented along with specific examples of the types of environmental issues that could cause conflicts with United States national security interests.

TABLE OF CONTENTS

ABSTRACT	III
PREFACE	VII
LIST OF ILLUSTRATIONS	IX
LIST OF TABLES	XI
ENVIRONMENTAL SECURITY: A STRATEGY FOR THE MITIGATION OF REGIONAL INSTABILITIES?..	1
UNITED STATES ENVIRONMENTAL SECURITY POLICY	2
ENVIRONMENTAL SECURITY AS A VITAL UNITED STATES INTEREST	3
THE GLOBAL ENVIRONMENTAL THREATS	4
POPULATION	4
WATER SUPPLY	6
Environmental Scarcity	7
FOOD	10
DISEASE	13
AVAILABILITY OF RESOURCES FOR ECONOMIC DEVELOPMENT	17
ENVIRONMENTAL SECURITY AND UNITED STATES MILITARY FORCES	18
CONCLUSIONS	20
ENDNOTES	23
BIBLIOGRAPHY	29

PREFACE

I dedicate this work to my wife and children who supported my efforts in its preparation and my attendance at the Army War College.

LIST OF ILLUSTRATIONS

FIGURE 1 - DISPARITY IN POPULATION GROWTH BETWEEN DEVELOPED AND DEVELOPING COUNTRIES.	5
FIGURE 2 - TOTAL WATER WITHDRAWALS IN THE UNITED STATES FROM 1900 THROUGH 1990.	7
FIGURE 3 - CHANGE IN SURFACE AREA OF THE ARAL SEA FROM 1960 THROUGH 2000. LAKE DEPTHS ARE GIVEN IN METERS.	8

LIST OF TABLES

TABLE 1 – WORLD SUMMARY OF UNDERNOURISHED PEOPLE. BETWEEN 1990-92 AND 1994-96, THE NUMBER OF HUNGRY PEOPLE INCREASED IN THREE OUT OF FIVE REGIONS.....	11
TABLE 2 – SALINIZATION BY COUNTRY THROUGH THE LATE 1980S (ADAPTED FROM GLEICK, <u>THE WORLD'S WATER 2000-2001</u>).....	12
TABLE 3 – SUMMARY OF POPULATION GROWTH AND MORTALITY FOR MAJOR REGIONS OF THE WORLD.	14
TABLE 4 – SUMMARY OF POPULATION GROWTH AND MORTALITY FOR SELECTED COUNTRIES.	14
TABLE 5 – EFFECT OF HIV/AIDS ON CHILD MORTALITY IN SELECTED COUNTRIES, 2002.	16

ENVIRONMENTAL SECURITY: A STRATEGY FOR THE MITIGATION OF REGIONAL INSTABILITIES?

Throughout the history of the United States, the definition of national defense has continually changed in response to evolving threats and national interests. Ever present is a requirement to protect the physical boundaries of the nation, but frequently the United States has employed its political, economic, and military power to protect national economic interests, explore new frontiers, protect the sovereignty of allies, and even provide humanitarian assistance. However, the current role of the United States as the world's sole hyperpower has produced unique challenges for the United States leadership. No longer is the United States confronted with a credible symmetric threat that challenges its physical security, but now faces an asymmetric threat from terrorist (non-state) organizations. Additionally, the United States faces the challenge of maintaining the functionality of a global economy that sustains and promotes United States prosperity and the United States position as a superpower. An important component of the United States effort to encourage the global economy is the use of political, economic, and military power to maintain the security of those States that provide either resources or markets for the global economy.

Of special interest to the United States, with regard to global security, are the developments of regional instabilities, which are often rooted in political, economic, or military unrest. These instabilities can hamper economic prosperity and provide breeding grounds for popular discontent. Consequently, the prevention or mitigation of regional instabilities is an important and potentially cost effective (as compared to war)^{1,2} strategy that can promote a global economy and reduce global terrorist organization recruitment and training activities.

Instabilities fall into three general categories; those caused or supported by external forces, internal disturbance, or a combination of the two.³ The first case is controlled largely by the relative political, economic, and military strengths of the States involved, but the later cases include popular support (or lack thereof) for a political power. The strength of popular support is greatly influenced by governmental policies, the national standard of living, and the strength of the economy.⁴

Often regional instabilities are found in developing countries where the standard of living is low, the economy is weak, and government policies are either impotent due to a lack of authority or repressive to maintain order. As a consequence of these factors (and sometimes as a cause of them), the populations of developing countries often focus much of their energy fulfilling the basic needs of food, water, shelter, and health care. If a population is unable to

meet these basic needs, internal disruption results. The causes of shortages are sometimes induced by humans for political advantage⁵, but often the root causes of shortages are found in the natural or anthropogenically modified environment in which the people live and work.

UNITED STATES ENVIRONMENTAL SECURITY POLICY

Several studies have attempted to develop a commonly accepted definition of environmental security without success.⁶ However, for the purpose of this paper, the following politically oriented definition is presented.

An environmental security issue is a component of the natural or anthropogenically modified environment that conflicts with a nation's stated national security objectives or policies.

This is certainly not a "green" definition, as it does not account for degradation of the natural environment (i.e., loss of plant or animal diversity, soil erosion, etc.) unless the nation's political leadership identifies an issue as a security hazard to the State or its citizenry. However, this definition does provide criteria for prioritizing environmental issues against other State interests.

In the United States, national security objectives and policies are formally presented in the National Security Strategy and are regularly updated by the President and members of the President's cabinet. As with all documents of political origin, the content and focus of the National Security Strategy changes with Administrations. As an example, the emphasis on environmental issues is notably different between the Bill Clinton and George W. Bush Administrations. In his 2000 National Security Strategy, President Clinton presented numerous environmental security topics to include energy security, greenhouse gas emissions, sustainable development, humanitarian activities, and several regionally focused comments concerning disease, food production, and economic security. Conversely, the Bush National Security Strategy presents a nonspecific discussion of a short list of issues that includes greenhouse gas emissions, energy security, public health, and agriculture development. Overall, the Clinton strategy is articulated in considerable detail concerning environmental security issues as compared with the Bush plan. However, the Bush National Security Strategy places a greater emphasis on decreasing regional instabilities, which by implication could include a number of environmental considerations.

As previously stated, the role of the United States military continues to evolve as threats to the United States change. Perhaps due to the citizen-soldier history of the United States military, many Americans perceive their military only in its role as a combatant. Actually, the

military often urges caution to the civilian leadership in exercising military force because of their understanding of the inherent risks associated with combat.⁷ In any case, the United States military typically undertakes only limited roles in the prevention of hostilities between States or non-state entities. This assistance is often provided in the form of deterrence through the presence of United States military forces (e.g., Cold War) and/or using United States forces to provide military training to indigenous forces (e.g., El Salvador).

The current United States policy concerning involvement in environmental security issues is not consistent. There are a number of United States agencies involved with environmental security activities to include the Department of State⁸ (DoS), Department of Agriculture⁹, Department of Defense¹⁰ (DoD), and the Environmental Protection Agency.¹¹ Each of these organizations operates within its own legislated guidance from Congress and implementation directions from the President. However, as per the 2002 National Security Strategy¹², the DoS is the lead United States organization for humanitarian assistance (HA), which includes environmental security programs.

ENVIRONMENTAL SECURITY AS A VITAL UNITED STATES INTEREST

Maintaining world order has increasingly risen in importance in United States foreign policy and in some instances has risen to the level of a vital national interest.¹³ While regional instabilities alone may not constitute a direct physical threat to the United States, secondary effects to include impacts on international trade,¹⁴ access to resources, and support bases for terrorist organizations¹⁵ can have ties to regional conflicts. There are many causes for regional instabilities to include ethnic and ideological differences, economic difficulties, religion, and nationalism to name a few.¹⁶ To complicate matters, most regional instabilities include combinations of issues, which create unique regional situations.

One category of issues that facilitate unrest is associated with physical impediments. These types of issues include disease such as malaria, hepatitis, AIDS, and tuberculosis;¹⁷ starvation caused by drought and poor farming practices;^{18, 19} water shortages created by water overuse, contamination, and drought;^{20, 21} poverty caused by a lack of raw resources, equipment, transportation systems, and energy sources;²² or natural disasters.²³ While these “environmental issues” may not provide the sole cause for a war, they can contribute to general discontent and accentuate other contentious issues.

In actuality, environmental security is a subset of aid provided under the umbrella of foreign humanitarian assistance. So, if these two programs are related, what is the significance of the distinction? First, the term humanitarian assistance (HA) carries a connotation of

immediate relief efforts to end suffering or deprivation. HA operations are normally of short duration,²⁴ and require the declaration of a foreign disaster by the DoS or United States Ambassador for implementation.²⁵ Finally, HA relief efforts can be executed in support of United States national interests, but may also support non self-serving humanitarian causes.

Conversely, an environmental security issue is one that by definition must be self-serving of United States interests with humanitarian consequences a secondary (but fortuitous) benefit. This distinction is significant when prioritizing resources to provide environmental security versus strictly humanitarian assistance. Also, while environmental security should demonstrate progress in the short term, the greatest benefits are normally produced over longer periods of time. The term environmental security does not inherently convey the same sense of urgency derived from humanitarian assistance. Indeed, this is an issue of semantics, but in the process of obtaining resources for environmental security programs, “words count”. Additionally, while environmental security operations are always conducted with the approval of the DoS or United States Ambassador, a formal disaster declaration is not required. Finally, the use of the word environmental is in vogue, and its use adds an additional level of legitimacy to the effort. Certainly within developed countries and to a growing extent in developing countries, the realization that natural systems and resources are finite in quantity and capacity is well established. Few endeavors, to include war, are initiated or sustained without recognition of the environmental impacts to humans, plants, animals, and the basic water, air, and soil systems that constitute the Earth.^{26, 27}

THE GLOBAL ENVIRONMENTAL THREATS

While the 2002 National Security Strategy specifically identifies four environmental interests with global implications (i.e., reduction of greenhouse gas emissions, improved public health, development of energy security, and promoting agricultural development²⁸), the environmental issues of greatest immediate impact for the United States will be those that “diffuse regional conflicts”²⁹ by promoting regional security through readily observable benefits to local populations. The primary issues of concern include population growth, water supply, food supply, disease control, and availability of resources (e.g., energy) for economic development.

POPULATION

The most common underlying cause for all environmental issues is population growth.³⁰ During the latter half of the 20th Century, population growth has increased dramatically largely

due to improvements in health care that have decreased child mortality and increased life expectancy. Also of significant importance are educational improvements, which have helped disseminate information on nutrition, increased food production, and assisted in the prevention of disease. In developing countries, the annual population growth rates averaged between 2.0 to 4.8 over the period 1990 through 2000,³¹ which translates to a doubling of the population in 35 years and 15 years, respectively³². World wide, the Earth's population is predicted to increase from 6.2 billion in 2003 to 9 billion by 2050³³. Figure 1 clearly shows the recent increase in world population and illustrates the greater growth rate in developing countries as compared to developed countries. This rapid population growth is responsible for the consumption of already limited water, food, and other resources of developing countries at an increasing rate.³⁴

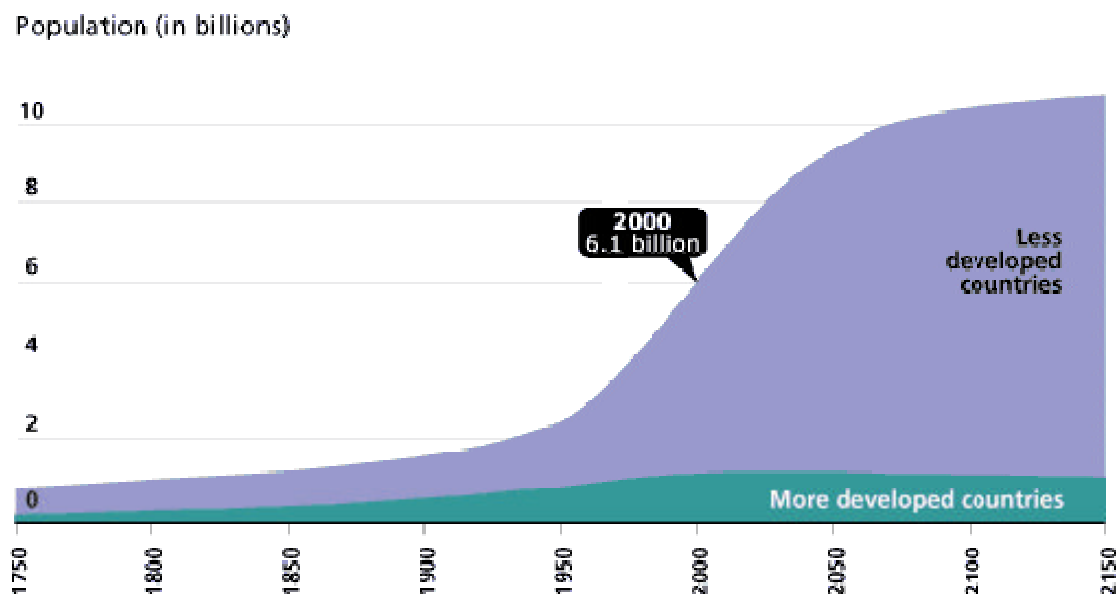


FIGURE 1 - DISPARITY IN POPULATION GROWTH BETWEEN DEVELOPED AND DEVELOPING COUNTRIES.³⁵

With increased population, shortages in both quantity and quality of water and food will correspondingly increase, along with the coincidental production of waste materials (residential and industrial) that pollute the water, air, and soil. In turn, these waste materials will further decrease available water supplies and food production sources, while promoting conditions favorable for the spread of disease. The resulting decline in standards of living and quality of life will cause impacted populations to become increasingly restless. The outlook for high population growth countries to develop sustainable food and water resources as well as viable

economies is poor unless population growth slows.³⁶ Therefore, as a fundamental environmental issue around the world, population growth must be addressed before other environmental actions can have a substantive effect. Population growth is caused by a combination of migration, high fertility, and low mortality.³⁷ Large scale migration either results from a search for economic opportunity or attempts to escape armed conflicts. These two causes provide some justification for United States assistance in economic development and regional security of those nations with traditionally high immigration rates to the United States (i.e., Central America or Mexico). On the other hand, high fertility rates are best addressed through education programs on reproduction though cultural and religious practices often oppose western ideas concerning population control. While the United States government should not seek to interfere directly in local religious or cultural practices, providing assistance in the establishment and sustainment of education programs and schools is a sound, long term initiative that can help a population manage its own growth.³⁸ Lastly, the overall benefits of lowering mortality rates are generally considered much greater than the negatively associated consequences on population growth.

WATER SUPPLY

If population growth is the most common underlying environmental issue facing a region, very likely the most significant result is the availability of fresh water. Water generally receives the most notoriety because the impacts of a shortage in either water quality or quantity are immediate and observable. Unlike other common environmental issues, in the absence of water, the existence of life rather than the quality of life becomes the immediate concern. Obviously, water shortage becomes more acute as the demand for water increases, and water demand will increase with population growth due to both increased individual consumption and irrigation for food crops. Approximately, 75% of the Earth's surface is covered by water³⁹, but only 2.9% of that water is fresh with 2.2% of the world's fresh water frozen in glaciers and the polar ice.⁴⁰ However, even with only 0.7% of the Earth's water available for human requirements (i.e., not frozen or saline), this amount would be sufficient for current human requirements if it were located near the centers of demand.⁴¹ Cities were originally established in locations that provided adequate fresh water supplies, but as population growth continues these supplies are becoming increasingly inadequate due to the volume of demand and contamination. In developing countries, 80% of the fresh water use is for irrigation of crops⁴², with similar withdrawals common in developed countries. Figure 2 shows water consumption in

the United States between 1900 and 1990. Except for the reduction in water demand between 1980 and 1990, this graph is typical of water demand in many parts of the world.

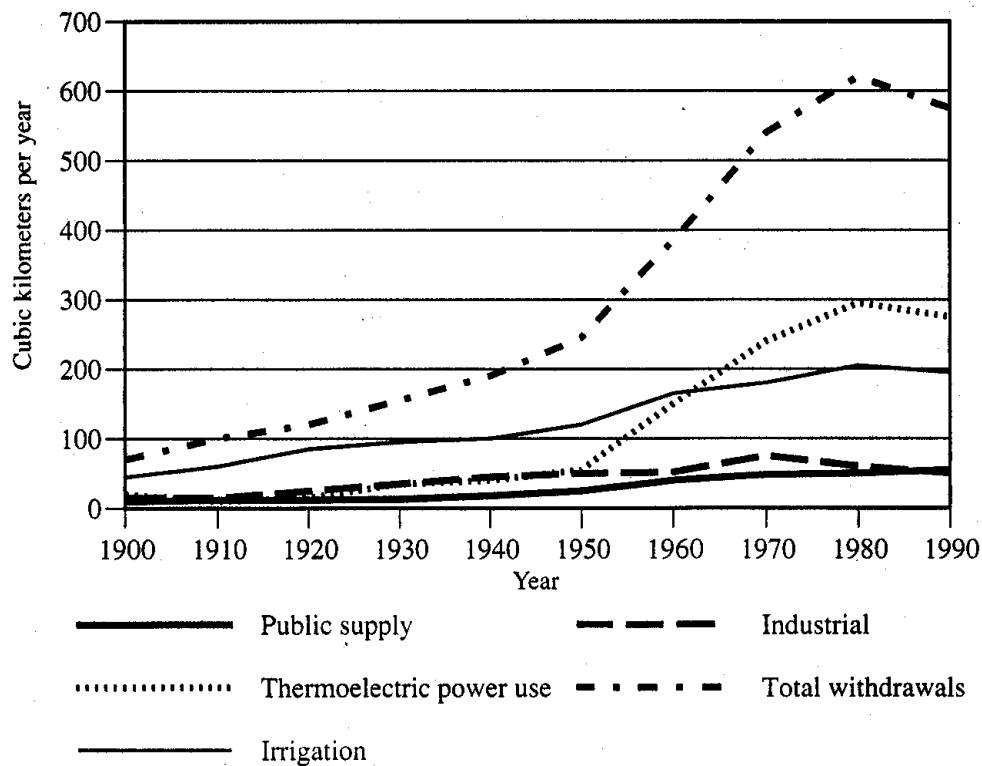


FIGURE 2 - TOTAL WATER WITHDRAWALS IN THE UNITED STATES FROM 1900 THROUGH 1990.⁴³

Environmental Scarcity

Many environmental issues can be described as a shortage of some resource (e.g., water, food, energy, etc.). Consequently, environmental shortages are categorized as *demand-induced*, *supply-induced*, or *structural* environmental scarcities.⁴⁴ An example of a *demand-induced* scarcity of water is the Aral Sea located between the Republics of Kazakhstan to the north and Uzbekistan to the south. Under Soviet Union control, an aggressive agricultural plan increased cultivation from 30,000 to 80,000 km² between 1965 and 1989. This particular group of projects typified many of the ills of poor water management and irrigation practices. First, between 1960 and 1998, the diversion of water from the rivers supplying the Aral Sea reduced surface inflow from 55 to 0 km³/yr.⁴⁵ This lack of inflow resulted in a decrease in the Aral Sea surface area by 69% or 47,000 km², and a 450% increase in salinity as the salts in the sea

concentrated due to evaporation.⁴⁶ Figure 3 portrays the time sequence changes of the Aral Sea from the fourth largest lake in the world to the eighth largest in only 20 years.

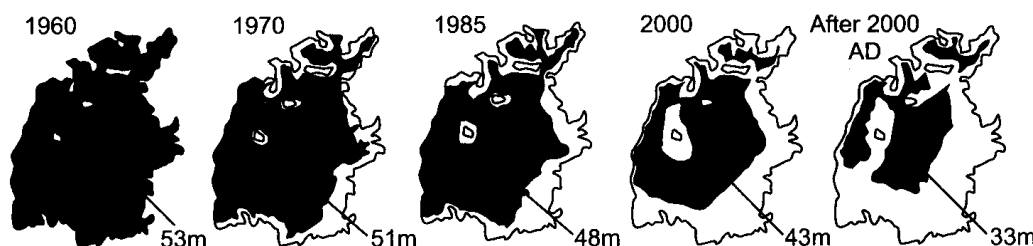


FIGURE 3 - CHANGE IN SURFACE AREA OF THE ARAL SEA FROM 1960 THROUGH 2000. LAKE DEPTHS ARE GIVEN IN METERS.⁴⁷

The consequences demanding a volume of water that was greater than the natural supply lead to a loss in fish habitat (e.g., loss of lake area) and declining water quality that crippled a once thriving fishery that was not only a valuable food source, but also a significant regional economic base.

A second example of *demand-induced* water loss is occurring in Palestine. The region has three sources of fresh water; rainfall, surface water from the Jordan River, and groundwater from three primary aquifers. A western aquifer drains toward the Mediterranean Sea, an eastern aquifer flows towards the Jordan River, and a northern aquifer flows towards Lebanon. The aquifer boundaries are located in Israel and along the West Bank. The Israelis have been very successful in developing sophisticated and efficient irrigation methods, but the volume of water required for these activities remains large. Between 1949 and 1989, the population of this region quadrupled in size, the area of irrigated land increased by sevenfold, and the total water consumed increased by eightfold.⁴⁸ Much of the irrigation water in Palestine is pumped from groundwater sources and is not being replaced at the same rate as withdrawal. The resulting condition is termed “water mining” and is partially irreversible if the soil matrix that held the water before withdrawal collapses upon water removal. The collapse of the soil matrix prevents future aquifer recharge to a capacity that could provide the original flow volume and rate. Consequently, a result of water demand in excess of natural recharge capacity can reduce the future capacity of a water supply and create a *supply-induced* environmental scarcity (e.g., nonrenewable consumption, degraded quality, etc. of a resource). *Supply-induced* water scarcities caused by water mining are unfortunately common with groundwater tables in parts of northern China falling at a rate of 1.5 m/yr and in India at rates of between 1 and 3 m/yr.⁴⁹ In the

United States, the best known aquifer, the Ogallala, which covers 453,250 km² in the central United States, has experienced water table depressions as high as 30m in depth.⁵⁰ Besides collapsing the soil matrix, an additional problem with water mining in the western aquifer of Palestine (and other aquifers in coastal regions) is “salt water intrusion” as Mediterranean Sea water replaces the fresh water mined from the aquifer and contaminates the remaining fresh water in the process. In extreme cases, the salt water intrusion will cause wells producing fresh water to become brackish and limit their usefulness for human consumption or irrigation.

In the case of salt water intrusion, the resource scarcity is manifested by poor water quality and not insufficient water volume. As population and the resulting discharge of waste and contaminants grow, water quality becomes an appreciably larger issue in water availability. In Gaza, the quality of the groundwater, the only water source besides rainfall, has decreased significantly due to salt water intrusion and chemical contamination. The Gaza aquifer system is already below sea level and continues to be drawn down by 15 to 20 cm/yr, which increases the rate of salt water intrusion from the Mediterranean Sea. The groundwater annually increases in salinity from 15 to 20 mg/L with 1995 salinities measured between 650 and 3500 mg/L.⁵¹ The United States Environmental Protection Agency does not recommend human consumption of water with salinity greater than 500 mg/L though higher salinities can be used for livestock and irrigation.⁵² Additionally, heavy regional applications of pesticides and fertilizers have contaminated the Gaza aquifers with chemicals harmful to human health. In many developing countries, hazardous chemical pesticides such as DDT (dichlorodiphenyltrichloroethane) are not banned and are still in common use. Compounding the pollution problem is the swelling human population, which produces a large volume of waste material for disposal. While chemical measurements do identify the presence and magnitude of the water contamination in Gaza, the most telling indicators of water pollution are the high levels of infant mortality, hypertension, infectious disease, and other health related problems. Fungal infections and intestinal roundworms are common, particularly in the refugee camps. A cholera outbreak was reported in November of 1994 in Gaza City caused by heavy rains that mixed untreated sewage with fresh water supplies.⁵³

Palestine also illustrates an example of the third type of environmental scarcity, *structural* scarcity. A *structural* scarcity is caused by imposed policies or regulatory controls. In 1967, Israel assumed control of all water supplies in Gaza and the West Bank. Under Israeli control, the Arabs living in these territories were not permitted to drill new water wells and pumping quotas from existing wells have been kept at approximately 1967 pumping levels. Restrictions on Israeli settlers have not been nearly as stringent with 36 wells drilled in the West Bank

between 1967 and 1989. The Israeli wells are typically deeper (200 - 750m) than the Arab wells (100m) and consequently produce a higher quality of water.⁵⁴ A striking example of the water distribution disparity in Palestine is in the Jordan Valley where in the late 1980s, Jewish settlers farmed one fourth of the cultivated area, but consumed 45% of the water used for agriculture.

Another form of *structural* water scarcity in Palestine is the different pricing policy that has been implemented for Israelis and Arabs. Using 1995 prices, Israelis paid \$0.10/m³ for water that cost approximately \$0.34/m³ to produce. Palestinians paid up to \$1.20/m³ for water from Arab water authorities. The disparity in access to water and cost of water is a source of considerable irritation between the Arab residents of Gaza and the West Bank with Israel.⁵⁵

FOOD

Hunger affected over 815 million around the world between 1997 and 1999.⁵⁶ The causes of food shortage are quite similar to those of water shortage. Rapidly increasing populations (*demand-induced* environmental scarcity), coupled with poor farming practices, climatic variations, and natural disasters (*supply-induced* environmental scarcity), and lack of access to farm land (or fisheries) due to land ownership and armed conflict (*structural* environmental scarcity) are all causes of food shortages. Population management is certainly one aspect of a food program, but of equal importance is assisting farmers in the production of larger yield and more sustainable crops. Unfortunately, many developing countries do not have natural “bread baskets” as found in the central United States and Canada, and therefore have greater challenges caused by less favorable soil types, water shortages, and climatic conditions. In addition, the impact of crop loss due to natural or man made disasters create greater hardships in developing countries due to the survival subsistence level of the populations who have neither the food reserves nor capital to purchase replacement food supplies.

Sub-Saharan Africa is noted for its recurring food shortages. All three types of environmental scarcity have been present in Angola, Ethiopia, Eritrea, Somalia, Mozambique, Malawi, Sudan, Uganda, West Africa, Republic of Congo, and Democratic Republic of Congo during recent years.⁵⁷ An extended drought during the 1990s complicated matters, as has sporadic civil war. Humanitarian assistance continues to be required in this region with the United Nations Food and Agriculture Organization estimating a decline in the 2002 grain harvest of 25 percent due to poor and late rains. The result is approximately 11 million people in Ethiopia alone are facing serious food shortages in 2003.⁵⁸ A historical perspective of the distribution of the world's hungry is presented in Table 2.

	Millions of People	
	1990-92	1994-96
Sub-Saharan Africa	196	210
Near East & North Africa	34	42
East and Southeast Asia	289	258
South Asia	237	254
Latin America & Caribbean	64	63
Total	820	827

TABLE 1 – WORLD SUMMARY OF UNDERNOURISHED PEOPLE. BETWEEN 1990-92 AND 1994-96, THE NUMBER OF HUNGRY PEOPLE INCREASED IN THREE OUT OF FIVE REGIONS⁵⁹.

While science has yet to find a way to control the weather, there are many improved farming techniques such as contour plowing, crop rotation, efficient irrigation methods, fertilizers, genetically engineered crops, and rangeland management that can improve agricultural sustainability and increase crop yield. Education of both farmers and government leaders is the first step in this process,⁶⁰ with availability to equipment, seed, and fertilizers important follow-on activities.

An exceptional example of poor farming practices accompanied the diversion of Aral Sea inflow for crop irrigation discussed previously. To extend the area serviced by irrigation, the cultivated lands were under-irrigated. Low flow irrigation creates salinized soils or a concentration of salts in the upper soil layer due to irrigation water evaporation and capillary migration of salts from soils below the upper soil crust. Irrigation water will initially dissolve salts in the soil below the surface, but if there is insufficient water to flush these salts deeper into the soil profile, the salt water solution migrates upward (capillary action) to the surface where the water evaporates. Over time, these salts increase in concentration and create a soil condition toxic to plant life. The long term loss of the Aral Sea fishery and agricultural lands due to salinization created new *supply-induced* environmental scarcity problems. Once salinized soils are formed, the process to reverse salinization is difficult and requires large volumes of fresh water that may not be available. Salinization of soils due to poor irrigation practices is not unique to the Aral Sea region and Table 1 presents a summary of arable land lost to salinization around the world.⁶¹

Country	km ² (x1000)			% of Irrigated Land Affected
	Cuyltivated Land Area: Total	Irrigated Area	Area Affected by Salt	
Argentina	358.0	15.0	6.0	40.0
Australia	471.0	18.0	2.0	11.1
China	1,000.0	480.0	67.0	14.0
Former Soviet Union	2,326.0	20.5	37.0	180.5
Egypt	27.0	27.0	9.0	33.3
India	1,690.0	421.0	70.0	16.6
Iran	148.0	57.0	17.0	29.8
Pakistan	208.0	161.0	42.0	26.1
South Africa	132.0	11.0	1.0	9.1
Thailand	200.0	40.0	4.0	10.0
United States	1,899.0	187.0	42.0	22.5
World Total ^a	14,737.0	2,271.0	454.0 ^b	20.0

^a The totals include countries not on this list.

^b This total represents salt-affected lands only in the world's irrigated areas. Another 312,000 km² are salinized in nonirrigated areas.

TABLE 2 – SALINIZATION BY COUNTRY THROUGH THE LATE 1980S (ADAPTED FROM GLEICK, THE WORLD'S WATER 2000-2001).

Another growing loss of arable land is caused by desertification. Desertification describes a landscape usually found on the margins of arid or semi-arid regions that becomes devoid of vegetation. Many of these areas have sustained healthy ecosystems and human habitation for thousands of years, but increasing human pressure for food from agriculture and livestock and natural resources for economic gain are transforming these regions into barren landscapes. A case in point is sub-Saharan Africa, where the marginal areas around the Sahara desert are becoming unusable because of forest harvesting for fuel and timber and overgrazing by livestock. The resulting loss of vegetation removes the cover that protects the soil from evaporation, and wind erosion loosens the topsoil, which prevents stressed plant life from reestablishing itself.^{62, 63} A similar situation is occurring in China where the Chinese Environmental Protection Agency estimates that the Gobi desert has expanded over 52,400 km² between 1994 and 1999.⁶⁴ The central United States endured a comparable experience during the early 1930's, when poor farming practices combined with several years of less than average precipitation contributed substantially to the Great Depression era "dust bowl".⁶⁵

Fish and shellfish have long been significant sources of protein and important components of some economies. However, with the industrialization of agriculture and aquaculture, high loadings of organic wastes along with fertilizers from agricultural runoff are producing excessive nutrient loadings in the receiving water bodies. High nutrient loadings cause rapid algal growths (algal blooms), which eventually die and provide food for indigenous aerobic bacteria. If the quantity of dead algae is sufficiently large, the bacteria will completely consume the oxygen in the water before their food supply is exhausted. Upon depletion of the oxygen supply, the other aquatic life (i.e., fish and shellfish) will die as well. The phenomenon causing algal blooms is termed eutrophication and is occurring with increasing regularity as the use of fertilizers increases. While eutrophication is a serious problem in developing countries, it is also a problem in developed countries. The largest recorded aquatic “dead zone” (i.e., low or no dissolved oxygen in the water) is located near the mouth of the Mississippi River and averages between 15,000 to 18,000 km² in size. This particular dead zone is caused by high levels of nutrient loadings (e.g., nitrogen and phosphorous) that runoff into the Mississippi River from farms located along the Mississippi River and its tributaries.⁶⁶

Also contributing to oxygen depletion in aquatic systems is the development of aquaculture farms, which raise fish or shrimp in large numbers within confined areas such as cordoned mangrove swamps.⁶⁷ An example is shrimp farming in Ecuador, which has increased six fold since 1980 to include over 1750 km². Governmental controls to stop expansion of shrimp farms and education programs on shrimp farm management have been in place for several years, but approximately one quarter of the Ecuadorian mangrove swamps have already been destroyed. Shrimp, once a leading national export of Ecuador, is now in decline due to poor shrimp farm management. In addition, the shrimp farms have negatively affected other local fisheries since the destroyed mangroves were an important part of the habitat for other fish and shellfish.⁶⁸ Regardless of the method causing eutrophication, the same long term loss of aquatic life is the result of short term economic gains.

DISEASE

There are several indicators of human health, but two of particular interest include childhood mortality rate and life expectancy. As would be expected, the regions of the world suffering from the highest mortality rates and shortest life expectancy include developing countries where fresh water and food availability is constrained and education is limited. Table 3 contains a summary of under 5-year old mortality rates and life expectancy of the major regions of the world, and Table 4 lists similar information for selected countries.

	Population		Life Expectancy at birth (years)	Under 5-year mortality rate (per 1000)
	(millions)	Avg annual growth rate (%)		
Data Year	2000	1980-2000	2000	2000
Sub-Saharan Africa	659	2.7	47	162
South Asia	1355	2.0	62	96
Middle East & North Africa	295	2.6	68	54
East Asia & Pacific	1855	1.4	69	45
Europe & Central Asia	474	0.5	69	25
Latin America & Caribbean	516	1.8	70	37

TABLE 3 – SUMMARY OF POPULATION GROWTH AND MORTALITY FOR MAJOR REGIONS OF THE WORLD.⁶⁹

	Population		Male Life Expectancy at birth (years)	Male under 5-year mortality rate (per 1000)
	(millions)	Avg annual growth rate (%)		
Data Year	2000	1990-2000	2000	2000
Mozambique	18.2	3.0	40	227
Burundi	3.4	1.2	41	196
Rwanda	7.6	1.2	41	219
Central African Republic	3.7	2.4	43	199
Afghanistan	21.8	4.8	44	252
Angola	13.1	3.2	44	217
Djibouti	0.6	2.3	45	184
Ethiopia	62.9	2.8	45	187
Somalia	8.8	2.1	46	221
Liberia	2.9	3.1	49	205
Eritrea	3.7	1.7	51	142
Uzbekistan	24.9	1.9	68	69
Iran	70.3	1.9	69	44
Honduras	6.4	2.8	71	45
United States	283.2	1.1	80	9
Germany	82.0	0.3	81	6
Canada	30.8	1.1	82	6

TABLE 4 – SUMMARY OF POPULATION GROWTH AND MORTALITY FOR SELECTED COUNTRIES.⁷⁰

As previously stated, the most readily observable degradation of the environment is the availability of fresh water and this observation extends to the spread of disease as well. The natural environment has a tremendous capacity to remove wastes from water through physical and biological means. However, as population densities increase, the volumes of animal and human wastes eventually overwhelm the natural cleansing systems and pollute the water consumed by downstream users. The result is water contaminated with waste products that are filled with bacteria, viruses, protozoa, and helminths (worms) excreted primarily from warm blooded animals. The existence and excretion of these organisms from the intestinal tracks of warm blooded animals is normal, and in a relatively clean water body, the indigenous microorganisms quickly consume the waste materials and contagions die. Unfortunately, in the presence of large quantity organic wastes, produced by industrial discharge and animal excreta, these problem organisms survive for extended periods. Upon human ingestion of pathogens, a number of water borne diseases can result including cholera, typhus, typhoid, and hepatitis. Parasitic ingestion of organisms such as helminths may not be fatal themselves, but can lead to generally poor health and a greater susceptibility to other, more deadly, diseases.

There are many severe and deadly diseases endemic in the developing world. Many diseases are water related and fall into the categories of waterborne, water-washed, water-based, or water-vectored. Waterborne disease such as cholera, typhoid, *Cryptosporidium*, *Giardia lamblia*, and *Legionella* are ingested from a water source. Other diseases, such as pathogenic bacteria, viruses, protozoans, and helminths, also use water as a transference medium, but can be transmitted through human-to-human or animal-to-human contact as well. Water-washed diseases are those related to poor hygiene and are often associated with eye irritation or skin rashes. Water-based diseases are those in which an organism spends a portion of its development cycle in water. Examples of water-washed disease are schistosomiasis and dracunculiasis. Finally, water-vectored diseases include malaria and yellow fever, which are transmitted by vectors (e.g., mosquitoes) living in water.⁷¹ Many diseases such as yellow fever, cholera, and typhoid remain deadly even in the 21st Century.

While the more traditional diseases remain endemic in developing countries, the spread of a new disease, HIV/AIDS, is rampant. The worldwide death toll in the 20 years since the disease was first identified is over 20 million with an estimate as high as 68 million deaths by 2020 unless immediate action is taken. Sub-Saharan Africa has been the most severely affected with 2.3 of the estimated world total of 3 million HIV/AIDS deaths in 2001. More than 20% of the adults in Botswana, South Africa, Zambia, and Zimbabwe were HIV positive in 2001.⁷² Additionally, the debilitation of immune systems within HIV/AIDS affected populations is

promoting a strong resurgence of other diseases such as tuberculosis.⁷³ A summary of child mortality from AIDS for selected countries is listed in Table 5.

	Under 5-year mortality rate (per 1000)		Child Mortality from HIV/AIDS (%)
	With AIDS	Without AIDS	
Sub-Saharan Africa			
Botswana	107	31	71
Zimbabwe	101	47	53
South Africa	97	61	37
Kenya	95	66	31
Zambia	171	133	22
Coted'Ivoire	153	132	14
Uganda	145	128	12
Nigeria	136	125	8
Caribbean			
Haiti	117	107	9
Asia			
Cambodia	103	96	7
Myanmar	101	96	5
Thailand	30	29	4

TABLE 5 – EFFECT OF HIV/AIDS ON CHILD MORTALITY IN SELECTED COUNTRIES, 2002.⁷⁴

The spread of HIV/AIDS has another devastating effect on populations with high infection rates. In addition to straining already poor health care systems, over half of all new infections in developing countries occur in people under age 25.⁷⁵ The resulting loss of the available work force creates additional national economic problems and desperate conditions for young children. Care for the sick, widowed, and orphaned is an increasing social and financial burden as the number of HIV/AIDS deaths grows.⁷⁶

The World Health Organization has identified HIV, tuberculosis, and malaria as the three major infectious disease threats in the world, accounting for approximately half of all mortalities in developing countries.⁷⁷ There is no medical cure for HIV and the effective treatments (e.g., AZT) are beyond the economic means of most people in developing countries.⁷⁸ As with agricultural assistance, the first line of action in medical care is basic education and counseling. Education is essential for the prevention of future infections and the continued spread of HIV. However, the suffering of millions is already acute and these people need greater access to at

least minimal health care, if not specialized care for those in advanced stages. President Bush well summed the world AIDS situation in his 2003 State of the Union Address as follows.

“Because the AIDS diagnosis is considered a death sentence, many (on the continent of Africa) do not seek treatment. Almost all who do are turned away. A doctor in rural South Africa describes his frustration. He says, “We have no medicines. Many hospitals tell people, you’ve got AIDS, we can’t help you. Go home and die.” In an age of miraculous medicines, no person should have to hear those words”.⁷⁹

AVAILABILITY OF RESOURCES FOR ECONOMIC DEVELOPMENT

While access to food, water, and health care are the essential ingredients for societal success, economic development is the engine that promotes and sustains progress. The natural resources required for development include ores, oil, coal, timber, minerals, fisheries, and water to name a few. Access to a particular resource is situationally dependent and a function of location, financing, trade agreements, treaties, and other elements of economic and political power.

However, there is one common consideration with regard to resource availability, sustainable development. Sustainable development is a concept that promotes the consumption of resources at a rate and in such a manner as to not cause significant degradation of the environment and the future availability of resources. In recent years, the United States has championed the concept of sustainable development, but United States history is replete with examples of unsustainable activity. The removal of wetlands in the Midwest has reduced the habitat for waterfowl and other wildlife, while decreasing the water storage of the region and its “natural” capacity to mitigate riparian flooding. Similarly, deforestation for timber and agriculture has caused similar consequences. On a larger scale, shortening of the Mississippi River by approximately 125 miles by cutting across bends in the river (i.e., oxbow lakes) to improve river navigation has increased the river’s water velocity and forced the deposition of river sediment farther into the Gulf of Mexico. As a result, the wetlands along the Louisiana coast are under nourished by river sediment and are being eroded by ocean waves at a rate of 90 to 104 km/yr.⁸⁰ These wetlands are an integral component of the coastal and Gulf of Mexico fishery and wildlife ecosystems. In Central America, the common practice of “slash and burn” agriculture is producing low yield crops, but more detrimentally is promoting erosion of the available topsoil, which is choking streams and rivers with silt and adversely affecting water quality. The loss of vegetation also removes the natural “buffer” to rainfall runoff increasing the frequency, size, and destructive capability of naturally occurring

floods. In South America, the harvesting of rainforest for timber in the Amazonian region also increases the rate of soil erosion and flooding frequency, but in addition destroys large masses of green plants that produce the earth's oxygen supply through photosynthesis of carbon dioxide. The annual rate of world wide rainforest destruction is approximately 31 million hectares with 2.1 million hectares lost annually in Brazil alone.⁸¹ As previously discussed, these problems are not unique to the Americas with similar problems of soil salinization, deforestation, water contamination, and water mining occurring elsewhere as well.

ENVIRONMENTAL SECURITY AND UNITED STATES MILITARY FORCES

The primary missions of the United States Unified Geographic Combatant Command (UGCC) are to shape the political-military environment, respond to crises, and prepare for future operations in the defense of United States national interests within their Area of Responsibility.⁸² Specifically, UGCCs plan and execute operations in support of objectives established by the United States civilian leadership. However, the Combatant Commander's options in protecting United States national interests include more than the employment of combat forces.⁸³ An important alternative is limiting or possibly preventing hostilities by addressing the primary and contributing causes for regional conflicts.

There are several incentives for non-combative engagement by a UGCC in a region, but the most common is to build trust, cooperation, and goodwill between the United States, a local government, and a local population. These types of ill feelings are growing, especially in developing countries.⁸⁴ Once established, trust and cooperation can be used as a connection (or leverage) to establish dialogue on other more difficult and contentious problems. A second reason for UGCC non-combative engagement is to address internal causes of popular discontent that contribute to State or regional instabilities. The most fundamental of these issues are the previously discussed environmental threats associated with access to water, food, and health care. There are also environmental issues (e.g., access to resources, trade markets, energy, etc.) that are not at the survival level but contribute to the general welfare by affecting the economy and consequently the standard of living. Finally, United States intervention into environmental issues produces a clear message that the United States is not focused solely on military force to achieve its objectives.⁸⁵

These reasons for a UGCC (and the United States in general) to pursue environmental security activities is inherently self-serving if the reasons are based on United States national security requirements. Fortunately, meeting United States security requirements and the humanitarian needs of a population are not mutual exclusive activities. While many

environmental initiatives do yield direct and observable results, the most important outcomes are those that provide sustainable relief and security for a population. Obviously, the success of any environmental intervention is related to the specific circumstances to include the severity of the environmental issue, the willingness of the host nation to accept assistance, and the actual success by the United States in completing environmental projects.

Most United States military environmental security operations fall under the category of security cooperation (theater engagement) plans. The implementation of security cooperation by UGCCs vary since each UGCC faces a different set of regional issues. In practice, UGCCs have implemented environmental security operations through a variety of means to include security plans⁸⁶ and specially created offices.^{87, 88}

Application of a United States interagency assistance program led by the military has precedent in recent history. During the early years of the Vietnam conflict, numerous United States government agencies operated independently in South Vietnam. In response to an inefficiency of action, President Johnson combined the United States Government Office of Civilian Operations and the Military Assistance Command Vietnam (MACV) Revolutionary Development Support. This new organization was designated Civilian Operations Rural Development Support (CORDS) and was headed by a civilian manager with the title Deputy to the Commanding General, MACV. Below this level, integrated provincial advisory teams were created, which included United States civilians, United States military, and host nation representatives. These teams developed into functioning, interagency organizations that yielded considerable success through unity of effort and maximization of individual agency strengths. The major shortcoming of the CORDS program was that it was implemented late during the United States involvement in Vietnam.⁸⁹

The goals (ends) for environmental security engagement should include an observable effect on the populace, a conveyance of the United States' desire to employ alternatives to military action to resolve a situation, and an attempt to establish trust and cooperation between the United States military and a local government and its people. The resources (means) available to accomplish environmental security missions include training and funding to help local populations improve themselves and the coordination of direct assistance from non-governmental organizations (e.g., International Red Cross, Doctors Without Borders, Save the Children, etc.) and United States governmental agencies (e.g., United States Aid for International development, Centers for Disease Control, Forestry Department, etc.).

Within its Area of Responsibility, the UGCC often has the largest, best resourced, and best trained staff of the governmental and non-governmental agencies (NGOs) present.

Because of this capability, the UGCC may be the best organization to coordinate the identification, prioritization, resourcing, and execution of environmental projects in a region.⁹⁰

The execution of an environmental program is not without staffing and funding costs. However, these can be offset if a program prevents armed conflicts involving United States military forces, prevents destruction that would later require United States support for reconstruction, or establishes a dialogue that facilitates the availability of host nation support for United States operations elsewhere in the region.

The goal of the UGCC should be to obtain as much funding, planning, staffing, and other resources as possible from other United States government agencies and NGOs to develop and complete environmental security projects. Success in engagement programs, and in particular environmental programs, requires a long term commitment that can only be achieved through a multi-organizational effort. Such coordination is difficult since each of the contributing organizations has an independent agenda. However, the UGCC is in a unique position to provide essential support such as interagency coordination, transportation, temporary shelter, force protection, communications, and coordination with local authorities, which may not be available or affordable to other organizations in exchange for cooperation and assistance. Therefore, a key element in implementing an environmental security plan is for the UGCC staff to find areas of compromise and mutual advantage between the interests of the UGCC, contributing organizations, and the host nation.

CONCLUSIONS

It is not the premise of this paper to assert that the United States should undertake numerous and widespread humanitarian assistance or environmental projects around the world. However, the threats posed by environmental issues are real and the magnitude of the consequences (as reflected by population growth) may grow, if left unchecked, beyond the capabilities of the developed world to address. The unprecedented increase of the human population has the possibility of creating human suffering through shortages of water and food, disease, and competition for economic resources that is unparalleled in history. Additionally, regional environmental programs are useful tools in building trust, cooperation, and goodwill between the United States and other nations. This goodwill can then facilitate dialogue on other more difficult and contentious issues affecting United States national interests.

In the end, the United States must be selective concerning which environmental issues are chosen because the needs are many and the available resources are relatively few. The preferred method of any intervention is to help the local population change itself, develop local

ownership of an issue, limit the exposure of United States citizens and allies to physical harm, and minimize the financial costs to the United States. Some specific recommendations concerning environmental security program initiatives are as follows.

- The United States should conduct regional environmental threat assessments to identify the threats, assess their short and long term severity, and prioritize the threats based on United States national interests.
- The United States and in particular UGCCs need to conduct security cooperation (engagement) programs as cost effective methods of building trust, cooperation, and goodwill with local governments and populations.
- Security cooperation programs must first address the basic environmental concerns of water, food, and health care before other regional development can sustain success.
- The lead United States agency for environmental security programs need not be only the DoS. The United States Military often has the greatest capability in a region and can effectively identify, plan, and execute environmental security programs.
- Environmental programs should be coordinated and resourced using multi-agency support to build on agency expertise and capabilities and distribute costs.
- Plan environmental programs as long term commitments. Immediate results should be observable from all environmental programs; however, most environmental problems require long term action. Almost all environmental programs require educational programs that must be continued over generational time periods to achieve sustainable results.

The particulars of environmental security issues vary by region and with the specifics of the economic, cultural, and political circumstances. In some situations, both NGOs and local populations may view the United States as an aggressor, but fair handed engagement can change these perceptions and assist the United States in its attempts to promote and sustain regional stability. Regardless of the details, the implementation of any environmentally oriented program requires local government and popular cooperation and cannot be imposed by a foreign power.

WORD COUNT = 7,332

ENDNOTES

¹ The cost of the 1991 Gulf War was approximately \$61 billion. "For the Gulf War it is worth noting that various members of the allied coalition reimbursed the U.S. for 88-percent (\$54 billion) of the amount shown, so the actual cost to the taxpayer was only about \$7 billion, roughly the same as for the Spanish-American War, and on a per capita basis only \$26.92, arguably the least expensive war in the nation's history". United States Civil War Center Statistical Summary, America's Major Wars, Available from <<http://www.cwc.lsu.edu/cwc/other/stats/warcost.htm>> Internet accessed 5 January 2003 (2001).

² The Bush Administration released a revised estimate for a possible 2003 war with Iraq of \$50 to \$60 billion. This revised figure was significantly lower than earlier Administration estimates for this conflict. Elisabeth Bumiller, "White House Cuts Estimate of Cost of War with Iraq", New York: New York Times, 31 December 2002.

³ Amin Saikal describes States as either cohesive or disrupted with some disrupted States reaching a point of being "out of control". Consequently, disrupted States are a main source of regional instability. Disrupted States can be further described by their degree of incapacity with the sources of disruption rooted in internal, external, or a combination of internal and external causes. Amin Saikal, "Dimensions of State Disruption and International Responses", Third World Quarterly, 21 no. 1, (2000): 39-44.

⁴ Saikal describes seven causes of internal disruption of a State, including ideology, cultural, and religious differences as well as political legitimacy and economic strength. While these causes provide a useful picture of internal disruptions, this author has identified the three areas of governmental policies, standard of living, and economic strength as the areas actionable by a State to address the internal disruptions identified by Saikal. *Ibid.*, 39-49.

⁵ Somali provides two examples of how resources such as food can be withheld from a population. First, years of civil war had prevented the planting and maintaining of crops with those crops actually harvested confiscated by tribal warlords for their use. Secondly, when international food aid did arrive, rival war lords pillaged large portions of the aid for personal gain and presumably to prevent the aid from supporting rival clans. John G. Fox, "Approaching Humanitarian Intervention Strategically: The Case of Somalia", SAIS Review, 21 no. 1, (2001): 147-151.

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¹¹ Office of International Affairs, Role of EPA's Office of International Affairs, (Washington, D.C.: U.S. Environmental Protection Agency) Available from <<http://www.epa.gov/oia/about/roleofioia.html>>, Internet accessed 15 October 2002 (2002): 1.

¹² George W. Bush. The National Security Strategy of the United States of America, (Washington, D.C.: The White House, September 2002).

¹³ John Sanderson, "The Changing Face of Peace Operations: A View from the Field", Journal of International Affairs, no. 55 (2002): 2.

¹⁴ Bush, 17-18.

¹⁵ Ibid., 5-7.

¹⁶ Saikal, 42-43.

¹⁷ National Intelligence Council, Global Trends 2015: A Dialogue About the Future with Nongovernmental Experts, (Washington, D.C.: Central Intelligence Agency, 2000), 24-26.

¹⁸ Joseph J. Romm, Defining National Security, The Nonmilitary Aspects (New York: Council on Foreign Relations Press, 1981), 26.

¹⁹ National Intelligence Council, 26.

²⁰ Peter H. Gleick, "Global Water: Threats and Challenges Facing the United States", Environment, 43, no. 2 (2001): 18-26.

²¹ National Intelligence Council, 27-28.

²² Bush, ii.

²³ Michael G. Sovereign, Humanitarian Assistance and Disaster Relief in the Next Century, Workshop Report, (Washington, D.C.: Department of Defense, 1997), 8-9.

²⁴ U.S. Joint Chiefs of Staff, Joint Publication 3-07, Chapter III.

²⁵ Ibid., III 4-5.

²⁶ Kent Butts, Environmental Security: What is DOD's Role?, (Carlisle, PA: U.S. Army War College Strategic Studies Institute, 1993): v.

²⁷ U.S. Joint Chiefs of Staff, "Joint Doctrine for Civil-Military Operations", Joint Publication 3-57, (Washington, D.C.: U.S. Joint Chiefs of Staff, 2001): III 7- III 8.

²⁸ Bush, 19, 20, 23.

²⁹ Ibid., 8-11.

³⁰ Daniel B. Botkin and Edward A. Keller, Environmental Science: Earth as a Living Planet, (New York: John Wiley and Sons, 2000): 5-10.

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³² The doubling time for a population growing at an “exponential” growth rate can be estimated by dividing 70 (the natural logarithm of 2) by the population growth rate.

³³ Population Research Bureau, Human Population: Fundamentals of Growth Population Growth and Distribution, Available from <http://www.prb.org/Content/NavigationMenu/PRB/Educators/Human_Population/Population_Growth/Population_Growth.htm>, Internet accessed 15 December 2002.

³⁴ Nicholas Eberstadt describes recent rapid population growth as “... ‘eating away’ at economic growth in poor countries, reducing or altogether canceling potential improvements in living standards and aggravating such conditions as poor health, malnutrition, illiteracy, and employment”. Nicholas Eberstadt, “Population Change and National Security”, Foreign Affairs, 70, no. 3, (1991): 115-116.

³⁵ Population Research Bureau.

³⁶ Anthony C. Beilenson, “Population Growth Is the Great Enemy of Foreign Aid: So Long As Current Trends Continue Their Money We Spend To Alleviate Poverty In The Third World Is Wasted”, Los Angeles Times, 23 July 1990.

³⁷ Some cultural practices and agrarian lifestyles traditionally produced high fertility rates, which were coincident with high mortality rates. Improvements in medical care have decreased the mortality rates, but not affected fertility. Eberstadt provides several illustrative examples of cultural differences that have led to regional changes in population distribution through rapid population growth. Eberstadt, 119-122.

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⁴⁰ Vernon L. Snoeyink and David Jenkins, Water Chemistry, (New York: John Wiley and Sons, 1980): 3.

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⁴² National Intelligence Council, 27.

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⁴⁴ Kimberley Kelly and Thomas Homer-Dixon, Environmental Scarcity and Violent Conflict: The Case of Gaza, (Toronto: American Association for the Advancement of Science/ University of Toronto, 1995): 6.

⁴⁵ P.P. Micklin, "Desiccation of the Aral Sea: A water management disaster in the Soviet Union", Science, 241 (1988): 1170-76.

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⁴⁸ Mirian R. Lowi, "Bridging the Divide, Transboundary Resource Disputes and the Case of West Bank Water", Foreign Relations of the United States, 9, no. 604 (1993): 117-119.

⁴⁹ National Intelligence Council, 27.

⁵⁰ Thomas V. Cech, Principles of Water Resources: History, Development, Management and Policy, (New York: John Wiley and Sons, 2003): 97-99.

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⁵³ Kelly and Homer-Dixon, 10-14.

⁵⁴ Lowi, 127.

⁵⁵ *Ibid.*, 8-9.

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⁵⁹ Food and Agriculture Organization of the United Nations, Factfile, Available from <<http://www.fao.org/news/factfile/ff9808-e.htm>>, Internet accessed 4 January 2003.

⁶⁰ Food and Agriculture Organization of the United Nations, Food for Thought: Education for Rural People, Available from <<http://www.fao.org/english/newsroom/news/2002/12280-en.html>>, Internet accessed 5 January 2003.

⁶¹ Peter H. Gleick, The Worlds Water, 2000-2001, (Washington, D.C.: Island Press, 2000): 269.

⁶² Botkin and Keller, 214-217.

⁶³ Goudie, 67-76.

⁶⁴ Dust storms have been documented in China for over 2700 years, but the frequency of major storms has noticeably increased in recent years. The Chinese Meteorological Agency recorded 5 major storms in the 1950's, which increased to 23 storms in the 1990's. During the first 2 years of the current decade, over 20 storms have already been recorded. The number of storms peak during late winter and early spring. These dust storms remove valuable topsoil from agricultural lands and have been so thick as to block the sun in Beijing. Geoffrey Leon, "Huge Dust Cloud Threatens Asia", London Independent, 26 January 2003.

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⁶⁶ United States Environmental Protection Agency, Mississippi River Basin Gulf of Mexico Web Site, Available from <<http://www.epa.gov/msbasin/mexico.htm>>, Internet accessed 3 January 2003.

⁶⁷ Botkin and Keller, pp 2-3.

⁶⁸ David Dudenhoefer, "Balancing Shrimp and Mangroves in Ecuador", Environmental News Service, Available from <<http://ens-news.com/ens/jan2003/2003-01-03-01.asp>>, Internet accessed 5 January 2003.

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⁷⁰ World Health Organization, 136-143.

⁷¹ American Water Works Association, Water Quality and Treatment, 4th ed, (New York: McGraw-Hill, 1990): 64-66.

⁷² Population Reference Bureau, "Facing the HIV/AIDS Pandemic", Population Bulletin, 57, no. 3, (2002): 16-17.

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⁷⁴ *Ibid.*, 16.

⁷⁵ Ibid., 8.

⁷⁶ Ibid., 27-29.

⁷⁷ World Health Organization, HIV, TB, and Malaria – Three Major Infectious Disease Threats, Fact Sheet, Available from <<http://www.who.int/inf-fs/en/back001.html>>, Internet accessed, 1 January 2003.

⁷⁸ Population Reference Bureau, 27.

⁷⁹ George W. Bush, State of the Union Address, (Washington, D.C.: The White House): 28 January 2003.

⁸⁰ U.S. Geological Survey, Louisiana Coastal Ecosystem, (Washington, D.C.: U.S. Department of the Interior, 2000), 1.

⁸¹ Rain Forest Action Network, Rainforest Fact Sheets, Available from <http://www.ran.org/info_center/factsheets/04b.html>, Internet accessed 25 February 2003.

⁸² William S. Cohen, Annual Report to the President and the Congress, (Washington, D.C.: Office of the Secretary of Defense), Available from <<http://www.defenselink.mil/execsec/adr2001/Chapter03.pdf>>, Internet accessed 3 January 2003 (2001): 29.

⁸³ In 1974, former Chief of the Joint Staff, GEN Maxwell Taylor wrote "... the National Security Council has concerned itself almost exclusively with issues of foreign and military policy, paying only incidental attention to relevant domestic matters and almost none to environmental factors of such critical importance to our security as the population explosion". Maxwell D. Taylor, "The Legitimate Claims of National Security", Foreign Affairs, 52, no. 3 (1974): 594.

⁸⁴ Richard Marin, "World Image of the U.S. Declines", Washington Post, (5 Dec 2002): A26.

⁸⁵ Bush, 9.

⁸⁶ Headquarters US Central Command, Environmental Security Supplement to USCINCCENT Theater Security Cooperation Plan (DRAFT), (MacDill AFB, FL: U.S. Central Command, undated).

⁸⁷ Center of Excellence in Disaster Management and Humanitarian Assistance, About Us, (Hawaii: U.S. Pacific Command, Tripler AMC), Available from <<http://www.coe-dmha.org/>>, Internet accessed 15 October 2002 (2002).

⁸⁸ U.S. Joint Chiefs of Staff, Joint Publication 3-57, I 8-9 and I 18-19.

⁸⁹ U.S. Joint Chiefs of Staff, Joint Publication 3-08, III 8-9.

⁹⁰ U.S. Joint Chiefs of Staff, "Interagency Coordination During Joint Operations, Vol I", Joint Publication 3-08, (Washington, D.C.: U.S. Joint Chiefs of Staff, 1996): I-2 to I-3.

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